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The Physiology and Hygiene of Sleep

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ingham, September 16, 1910

By

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PREFACE

The following pages do not purport to be an exhaustive treatise on the causes of sleep. An analysis in technical terms of the physiological conditions underlying the state of sleep, would have been out of place if given to the audience to which the following lecture was addressed. Just so much of the physiology of sleep could be entered into as enabled my hearers to follow the practical applications that constitute the "hygiene" of the subject.

It is, however, hoped that those desirous of getting some idea of what sleep means and what the loss of it entails, may find these pages neither disappointing nor uninteresting.

The Birmingham and Midland Institute,

September 16th, 1910.

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The Physiology and Hygiene of Sleep.

MR. CHAIRMAN, LADIES AND GENTLEMEN—

The phenomenon we call sleep is very interesting from more than one point of view. Were we so inclined, we might study sleep in the spheres of religion, philosophy, art and poetry.

Sleep and dreams are of no little importance in the Old and New Testaments and in most of the sacred literature of all nations. We have but to remember what resulted from that "deep sleep" of Adam, or to think of how many in all ages have found comfort in the words, "He giveth His beloved sleep"; "She is not dead but sleepeth."

Probably no physiological condition is so prominently before the poets as sleep—"Sleep and his brother Death" as Shelley puts it. The wonderful lines of Shakespeare, are hackneyed only to those who do not believe that—"a thing of beauty is a joy for ever."

"Sleep, O, gentle sleep,
Nature's soft Nurse! how have I frightened thee!
That thou no more wilt weigh my eyelids down
And steep my senses in forgetfulness."

We might on the other hand remind ourselves of the peculiar view that sleep is the normal and natural condition of mankind, while our waking states are a series of more or less disagreeable interruptions of a blissful unconsciousness. It is perfectly true that as regards the infant, its periods of wakefulness *are* of the nature of intrusions into its otherwise unbroken sleep.

But our study this evening is the Physiology and Hygiene of Sleep; that is to say, we set ourselves to ask and answer the following questions:—What is sleep as a state of brain? What is sleep as a state of mind? and what must we do to ensure the onset and continuance of healthy sleep? The first is a question of physiology, the second of psychology, the third of hygiene.

Now nothing is easier than to ask what is called "a simple question," but it does not by any means follow that a simple question can of necessity or at all times have a simple answer.

It does not follow that because sleep is so exceedingly familiar to us, we have attained to complete understanding of all its causal factors. For it does not necessarily follow that the recurring state which we so succinctly name "sleep" is itself the result of only one easily recognisable cause. In

other words, we ought to be prepared to find that there may be more than one type of sleep, just as there is more than one type of walking, or swimming or talking.

And it is equally true that although we can describe sleep in technical terms, we need not thereby be much nearer a comprehension of its causal antecedents.

Normal, dreamless sleep is the resting time of that part of the brain related to consciousness, but in proportion as dreaming is present, the abolition of consciousness is incomplete.

Physiologically, sleep is diminished or abolished activity of the cortex cerebri; psychologically, it is rhythmically recurring periods of unconsciousness terminating in a spontaneous return of consciousness.

There is a rhythm or periodicity about the onset of sleep which is normal or healthy—the basis of the “habit” of sleep so valuable to those possessing it, so difficult to re-acquire by those who have lost it.

On the speculative side we may connect this rhythm in the occurrence of sleep with those great cosmic and vital rhythms around us—the rising and setting of the sun, the ebb and flow of the tide, the opening and shutting of the flowers, the periodicity in the action of the heart and so forth.

Most animals with a nervous system rest at regular intervals even when they do not actually lose consciousness. The more lowly the nervous system of animals the less do they sleep: fish *e.g.* never truly sleep.

The brain—cortex cerebri—like so many other organs has a functional rhythm, it is not continuously in full activity; it works, it rests. When it works we are conscious, when it rests completely we are unconscious; a dream is, physically, the partial activity of an otherwise resting sensory or higher centre; psychically it is the arousing of the particular kind of consciousness related to the centre or centres in question. Apparently in normal conditions, the adult brain requires to rest some seven to eight hours out of the twenty-four; later on I shall give you what I believe to be the proper number of hours of sleep at different ages, but I may say that I do not believe women need less sleep than men.

Now we all know that a *state of healthy fatigue* precedes the onset of healthy sleep; and that, when in good health, we awake rested, refreshed and fit once more for the labours of a new day. Fatigue, whatever it is, is removed during sleep, and completely only during sleep. Now as a certain amount of fatigue is inevitable if physical or mental work is to be done, and as fatigue cannot be entirely removed except in sleep, it is at once obvious that unless fatigue is to go from bad to worse, sleep is an absolute necessity.

It has been fully proved that loss of sleep is a more serious condition to the body than loss of food.

In absence of food, the brain lives on the muscles, and rests periodically as usual; in loss of sleep, the brain never gets

any rest, and it is too delicate a mechanism to work continuously.

This is just the difference between a delicate non-living mechanism like a watch and the delicate living mechanism the brain—the former never becomes fatigued.

Professor de Menacéine, of St. Petersburg, kept some puppies awake for five days at the end of which time they died, although they were taking food; whereas the controls, which were allowed to sleep as much as they liked, but from which food was entirely withheld, survived to the twentieth day and were saved by being cautiously fed. A sleepless animal at the end of three to four days is as miserable as a starved one at the end of ten to fifteen days.

Prolonged sleeplessness in the human being damages the brain and nervous system most, but other grave bodily changes occur; the temperature becomes sub-normal, the number of blood-corpuscles is diminished, the specific gravity of the blood is raised, the various reflexes are irregular and enfeebled.

A certain amount of sleep, then, is equivalent to a certain amount of food. People who sleep on past breakfast time are often not particularly hungry when they wake, and are quite pleased to wait till lunch.

Now as I have so often said, science is a search for causes, so that we must in the next place try to discover what are the conditions that lead to sleep; if we knew these fully, we might be able to treat some causes of insomnia more rationally than at present we are able to do.

The first thing to ascertain is what are during sleep the objective variations from the normal waking state of the body.

Now I am not going to detain you at this time with an essay on the physiological states of all the organs during sleep; but shall only point out the more easily ascertainable alterations. As everyone knows, the *muscles* pass into a state of diminished tone, they relax; but as the muscles and their antagonists relax simultaneously and to the same degree, there are no distortions of limbs produced. The levators of the upper eyelids having, however, no antagonist on relaxing allow the lids to fall, and thus light is prevented from stimulating the retina. The muscles of the neck which hold the head erect also relax and allow the chin to fall forward on the chest, so that not only Homer, but millions of less well-known persons "nod" ere they fall asleep.

As regards the circulatory system, the heart beats less frequently and less strongly, the general blood-pressure falls, and the vessels of the skin are dilated giving the flush to the "sleeping beauty."

The respirations are shallower but rather more prolonged, less air and therefore less oxygen is absorbed, and less CO₂ evolved in a given time. In consequence of all this the production of animal heat is diminished and the temperature falls. Less urea is eliminated. All these facts point to one con-

clusion: that general metabolism is decreased in energy, that is, that the tissues are to a certain extent resting.

The *digestive apparatus* and its glands are not, however, nearly so inactive as was at one time believed. The distinguished Russian physiologist, Pawlow, has proved that digestion is active, e.g., in the sleeping dog. The late supper is digested; the dreams it may give rise to are due, not to its not being dealt with, but to the unusual muscular activity necessary to deal with it at a time when the stomach is usually inactive.

The digestive glands and the glands of the skin are now known to be active in sleep. Owing to the activity of the skin, a *chill is so easily taken during sleep*, for not only is heat being parted with through the skin but its glands are also perspiring and, therefore, if the bed-clothes fall off or are insufficient, the loss of heat may be very considerable before consciousness is awakened to rectify matters. The loss of heat in sleep is of course the reason why, when persons have to sleep in the open air, or in rooms without windows—the open air cure—the body must be very thoroughly covered with non-conducting materials. With the exception of the glands just mentioned, the entire body is resting in sleep but the central nervous system is resting most profoundly. It is, however, accessible to stimuli above a certain degree of intensity; if it were not so we could never be awakened.

The sense-organs and brain are not absolutely but only relatively inaccessible to stimulation. Whereas a noise of a certain intensity will not, a louder noise will penetrate to the centre for hearing and may awake the sleeper. A sensory stimulus may not in all circumstances wake the sleeper, but it may elicit, through the central nervous system, a series of reflex actions. Thus the sleeper spoken to may only move uneasily and re-adjust his position in bed or he may even say a word or two. Using this knowledge, certain thieves in India manage to steal the mattress from underneath a sleeping person without awakening him.

Motor actions of a fairly complicated kind can be carried out during sleep. As a result of a dream, a person may speak more or less coherently, and even walk a considerable distance. (Somnambulism.) The barking or growling of dogs in sleep is undoubtedly a dream motor-overflow. These acted dreams are due to overflowings of nerve-energy aroused by the dream-activity of certain sensory centres actuating lower level centres for the carrying out of more or less complicated muscular co-ordinations with which consciousness has nothing whatever to do. What is said in sleep is not remembered, what is done in walking is not recalled. The somnambulist may tread in the most dangerous places and yet maintain his balance; if awakened, he may lose it and injure himself severely.

Accessibility to stimulation is the basis of the methods for testing the depths or intensity of sleep.

As long ago as 1863, Kohlschütter made experiments, since corroborated, on the relationship between the intensity of a sound necessary to awaken a sleeper, and the time that had elapsed since he fell asleep. A metal ball was allowed to fall from varying heights on to a metal surface and the results were plotted as shown on the screen.

Along the *abscissa* is time in half hours, along the *ordinates* are heights from which the ball was dropped which awakened the sleeper.

It is seen that at the end of the first hour the ball had to fall through 800 units, whereas at the end of two and a half hours it needed to fall through only 50 units to have the same result. Sleep, therefore, during the first two hours or so is the most profound and therefore the most reparative and valuable.

The fact that the *first two hours of sleep are the soundest* and most refreshing is probably the foundation of the saying that two hours before midnight are worth several afterwards, and that these two hours are those of the "beauty sleep."

Now, while it is convenient to analyse the state of normal healthy nocturnal sleep, we must remember that it is allied to a number of states of brain all characterised by more or less complete abolition of consciousness.

These are:—

1. The hypnotic trance, the cataleptic trance or artificially induced sleep; sleep by suggestion: related to this is the state of narcolepsy, lethargy, or human hibernation.
2. The unconsciousness occurring in syncope, fainting, collapse, exposure undoubtedly related to grave cerebral anaemia.
3. The unconsciousness occurring in concussion or shock.
4. True coma, the unconsciousness related to auto-toxic aemic conditions—uraemia, glycohaemia, asphyxias, etc.
5. The more or less complete unconsciousness (narcosis) resulting from the absorption of some narcotic—the bromides, chloroform, opium, alcohol, ether, chloral, sulphonal, and other "hypnotics."

We may now attack the central problem—"what are the causal factors involved in the production of sleep?"

It will simplify matters if I say that I think there are four types of sleep related respectively to the following four conditions:—

- 1 Chemical substances,
- 2 State of the circulation,
- 3 Presence of sensations,
- 4 The more purely psychic activities,

so that we may for convenience speak of a *chemical*, a *vascular*, a *sensory* or a *psychic* type of sleep.

Now, it can admit of no manner of doubt that the chief causal antecedent of normal sleep is healthy fatigue.

We cannot sleep if we are not tired, though we may be "too tired to sleep."

Fatigue is now regarded as really a toxæmia, there being in the blood certain toxins or soluble poisons manufactured by the activity of the tissues—both nervous and muscular—during the preceding period of wakefulness.

The muscles, the nerve centres, and the glands all make their contributions of fatigue-toxins.

On the chemical or toxine "theory" of sleep, the toxins affect the *neural synapses* in such a fashion as to raise the resistance at these junctions and so retard and then prevent the passage of nerve-impulses of ordinary intensity across them. (See the illustrations).

The actual cause of the raised resistance *may be the retraction* of the excessively delicate terminals at the synapsis; but whatever be the precise mechanism, the resistance to all incoming (sensory) impulses is so raised that they fail to reach the sensory centres.

Many well known drugs and poisons, nicotine, curare, atropine probably act similarly by raising the synaptic resistance.

This functional isolation of the cells of the brain related to consciousness is psychically the unconsciousness of sleep, always provided that certain cells are not kept partly awake by errant dream-producing impulses.

Thus the chemical and the sensory factors both co-operate to bring about the sleepy state or "somnolence"; the fatigue-toxins raise the synaptic resistance to such a degree that the sensory impulses fail to reach the cerebral areas connected with consciousness; consciousness, therefore, for the time being vanishes.

A large accumulation of fatigue-toxins produces sleep under almost all circumstances. There is no resisting the onset of chemically caused sleep. As my learned friend Sir James Sawyer puts it, we suffocate our cells in "the ashes of our waking fires."

Many of the camel-drivers in Kitchener's forced march to Khartoum fell from their seats in sheer exhaustion and *slept* there and then on the sand while the whole army corps thundered past. In the old coaching-days postillions often fell asleep on horseback and yet rode on in the saddle.

You may remember that De Quincey's "Vision of sudden Death" was written after he had been driven at thirteen miles an hour by a driver fast asleep on a mail coach. Sentries have fallen asleep on their feet from utter exhaustion and have retained their balance.

More than once the cross-channel swimmer, Holbein, has been noticed by the men in the boat to be swimming asleep, *i.e.*, the neuromuscular toxins had poisoned and isolated the

cortical synapses, but had not similarly disabled those of the spinal cord through which impulses for the co-ordinated reflex actions of (unconscious) swimming were still possible. The spinal cord does not sleep, then, in the sense that the brain does; as it is not related to consciousness, so neither does it suffer in its reactions when consciousness is abolished.

A friend of mine (a retired Colonel of Volunteers), told me that after going through twenty-two hours of extreme fatigue in connection with the great Volunteer Review of 1881, he walked in his sleep in the dark for several miles along a coast road in Fifeshire.

A similar experience of an officer is related in Kipling's "Stalky and Co."—"after that, I went to sleep; you can, you know, on the march when your legs get properly numbed. Mac swears we all marched into camp snoring, and dropped where we halted."

Extreme sensory stimulation or the endurance of long continued pain finally brings on sleep. In the "good old days" of torture, people used to fall asleep on the rack. A vivid instance of sleep after prolonged "bullying" (physical and mental pain), is also given in "Stalky and Co." "When Fairbairn had attended to me for an hour or so, I used to go bung off to sleep on a form sometimes."

Here the excessive activity of the cells of the sensory centres probably produces neural toxins which, by a kind of self-preservative mechanism, so raise the synaptic resistances that further impulses are debarred from gaining access to the centres and so keeping them awake.

Physiologists have, of course, attempted to identify these sleep-producing substances in the blood. Preyer believed that lactic acid was large responsible for somnolence. He thought that it was oxidised off during the night.

Now it is quite well-known that occasionally in conditions of excessive fatigue, sleep is often impossible for many hours—we are too tired to sleep. Children more especially complain of this. Possibly here the insomnia is partly due to pain or discomfort arising from the over-exercised muscles, tendons, or ligaments, and partly due to the fatigue-toxins having actually an irritant instead of a narcotic effect on the sensory cells.

Acting normally in co-operation with fatigue-toxins the absence of sensory stimulation is a cause of sleep.

Everybody knows that we get off to sleep best when we retire into the darkness and exclude the sounds of the outer world. Within limits, sensations keep us awake until they are of such duration as to produce fatigue—*e.g.* the constant rattle of the railway train in which, as soon as we are tired, we can sleep quite well.

Sensations other than those through the eyes and ears can keep us awake—those of heat or cold or of pain are all efficacious. This sensory factor in sleep is then essentially a negative one, the absence of sensation conduces to sleep, its presence to

sleeplessness. Long continued sensory impressions—"droning" reading or preaching—may permit of sleep by virtually ceasing to be sensations engaging consciousness. Any persistent not very vivid sensation—the contact of the air, our clothes, &c.—ceases in time to be, for us, a conscious perception at all.

Having once become accustomed to sleep say in the noise of a great city, the quiet of the country so arrests the attention that sleep for some people is at first not possible.

For though this is physiologically the absence of sensation yet it is psychologically the engaging of consciousness which is of itself sufficient to prevent sleep. Strictly speaking this is a case of insomnia of psychic origin.

The onset of sleep, as due to the withdrawal of sensations, is strikingly shown in a case known as "Strümpell's boy." This was a boy of sixteen years of age living in Leipzig who suffered from the following sensory abnormalities—he was insensitive to touch, he had no sense of smell or taste, no muscular sense and no sense of pain (analgesia), he was deaf in the right ear and he was blind in the left eye. If now his left ear was stopped up and his right eye bandaged, he fell sound asleep in two or three minutes.

Persons whose sensory content is very limited, through rudimentary education. &c.,—such as Russian peasants, fall asleep very easily.

We may now pass on to the *vascular factor* in the production of sleep. Most authorities have come to the conclusion that sleep cannot set in unless there is a *diminution in the vigour of the cerebral circulation*. Some of the earliest observations on sleeping persons and animals report a state of relative anaemia, *i.e.*, diminution of velocity of blood-flow, and therefore in unit time less blood, in the vessels of the brain.

Some physiologists, while admitting that this diminution in the cerebral circulation occurs, hold that it is a concomitant but not a cause of sleep. First then let us bring forward the evidence in regard to this vascular factor.

Blumenbach in 1795 was the first to observe that the blood-supply to the brain was diminished in sleep; this was seen through a wound of the skull.

Arthur Durham in 1860 trephined a dog's skull and inserted a glass window into the hole. He noticed that the brain became paler when the animal was asleep. By ligature of the carotid arteries he produced a condition resembling sleep in which the brain was similarly pale.

Direct inspection of the exposed brain of sleeping animals has convinced Mosso and Tarchanoff that the surface of the brain has relatively less blood than in the waking state.

Now one result of there being less blood in the cranium during sleep is that the pressure of the cerebrospinal fluid between the brain and the skull would be slightly less, and, therefore that the dura mater would press less strongly on the cranial vault. Accordingly in the infant with anterior fontanelle, this

membrane is seen to be depressed during sleep and elevated during wakefulness.

Tarchanoff has demonstrated that the only position in which puppies *cannot* go to sleep is that in which their heads are lower than the level of their bodies.

Leonard Corning in America induced sleep in an acute maniac by compression of the carotid arteries.

Interesting corroborative evidence as to the reduced energy in the cerebral circulation may be found in the observations of Hughlings Jackson on the retinae of somnolent children. In every case he found the retinae decidedly less vascular than in the fully waking state; as sleep passed off the vessels of the eye filled up.

But we have still other evidence that the blood-supply to the brain is diminished before and during sleep. The method consists in converting the skull into a plethysmograph.

The infant skull by reason of the existence of the fontanelle is a natural plethysmograph for the brain; a tracing got from it falls in sleep.

Mosso in 1881 applied a plethysmograph to wounds in the skulls of several patients and obtained similar results.

It is very well known to surgeons that in fracture of the skull the cerebro-spinal fluid is greatly diminished in its flow or does not flow out at all during sleep.

Besides employing cerebral plethysmography, we can make *the arm or hand* tell the same story. If the arm be enclosed in a water plethysmograph, then it is noticed that as sleep comes on the volume of the arm increases, when sleep passes off the volume of the arm diminishes. There is a reciprocal relationship between the intra-cranial and limb volumes, for undoubtedly if less blood is now in the brain the excess must be accommodated elsewhere, and in the limbs as parts of that "elsewhere."

The first plethysmographic tracing shown is of the hand of a sleeping person; it is by Professor Howell, of Baltimore and is "inverted," *i.e.*, the downward direction (below time-line) indicates dilation of the hand or increase of its volume; conversely, tracings towards the time-line indicate relative emptying of the hand.

The experiment was begun at 1.22 a.m., the hand-volume is seen to increase, but to undergo a sudden emptying and then steadily to increase until the person fell asleep about 1.35 a.m. The volume of the hand now undergoes irregular variations; at about 2.35 the volume had decreased considerably, but at 2.52 the hand began to swell again; by 4.22 it had shrunk again, and once more at 5.22; at about 5.35 it began to shrink rather rapidly, and by 5.52 it had returned to its normal volume; the person was awake. Now if, as we have good reason to do, we take these variations in blood-content of the hand as indicating inversely the amount of blood in the brain, it comes to this, that when the tracing falls the volume of blood in the

brain is diminishing and sleep is coming on, when the tracing rises blood is increasing in the brain and sleep is passing off.

The next tracing is from the arm : it also shows fluctuations, but is specially selected to show the effect of sensory stimuli, one insufficient, the other sufficient to waken the sleeper. Each time the musical box was played, the volume of the arm diminished, *i.e.*, the volume of the brain increased—(this tracing is "natural," *i.e.*, a downward direction means shrinking, and an upward direction filling), so that although the person did not wake, the sound of the music was enough to send a little more blood to the brain.

It does not need all this scientific investigation to tell us that much blood is in the warm skin during healthy sleep. If the skin holds more, the brain must hold less, since the volume of the blood in the body is constant. That the blood-pressure in the arteries actually falls in sleep has been proved for animals by the Russian physiologist, Tarchanoff.

But in yet another way can we prove that there is an altered distribution of blood in the brain. The genius of Mosso devised in 1884 the method of "*the human balance*"; a person awake is accurately balanced on a table and allowed to fall asleep; as he does so, the foot end of the table sinks. The angle through which the table dips is a measure of the depth of sleep. The change in weight may be as much as corresponds to the weight of 260 c.c. of blood.

These and other researches have shown that this altered distribution of blood begins *before* sleep has set in; *i.e.*, blood leaving the brain is a cause of sleepiness (somnolence). Sleep is "*propter*" not merely "*post hoc*." Thus, before sea-sickness some people become somnolent; here the blood is leaving the head as is shown by the pallor of the face. In extreme cold—in balloons, at high altitudes people become sleepy; here the vigour of the cerebral circulation is greatly diminished by the enfeebled heart suffering from depression of vitality through the general depression from loss of heat. The question at once arises what is normally the cause of this diminution of blood to the brain which precedes sleep?

The answer is, dilatation of the arterioles in the skin and in the viscera of the abdomen; both factors to co-operate; Howell thinks the former the more important, Leonard Hill the latter. Either would cause the fall of general blood-pressure which occurs. But we need to know more than this; for naturally one asks why do the peripheral arterioles dilate towards evening? I have time for no more than to reply, it is due to fatigue of the vaso-motor centre as the day wears on; the toxins of fatigue begin to inhibit the excitability of the vaso-constrictor centre which accordingly innervates less intensely the cutaneous and visceral arterioles. This fatigue-depression of the vaso-motor centre is phasic or rhythmic; normally it comes on towards evening and increases until sleep supervenes.

We know that as evening comes on there is more blood in the

skin than there was earlier in the day: people's collars and rings feel tighter in the evening.

The rhythm of the activity of this centre is in some way probably related to the great diurnal rhythm of night and day.

This was illustrated in the extraordinary case of Caspar Häuser, a boy abandoned in the streets of Nüremburg at the age of seventeen. His childhood had been spent in "absolute solitude, having no knowledge of men, animals or plants." He always went to sleep as soon as the sun had set. Old people, from the weakness of their cerebral circulation, go off to sleep frequently for short periods especially when in a sitting posture. This was a feature of the last few months of the life of Queen Victoria; she would often be found asleep in the carriage.

The *last causal factor* in the onset of sleep is the absence of marked mental occupation or activity.

Everybody knows that "anything on the mind" will prevent sleep, whether that something be grief, joy or a mathematical problem. Unconsciousness is incompatible with vigorous cerebration.

No doubt this psychical factor is intimately dependent upon other conditions, the cardiac, and the sensorial. Thus the mind will be very much awake after experiencing an unusually vivid series of sensations, children's visit to a pantomime or a menagerie, or merely in consequence of a too energetic heart-beat. According as there is increased blood-flow through the brain from any cause there will be increased flow of ideas through the mind. Thus it is that conversational powers are so much better after than before, dinner.

Now just as there are four types of sleep, so there are *four* corresponding *types of insomnia*: a chemical, a vascular, a sensory, and a psychic.

I cannot now tarry to investigate these from their physiological aspects; but as types of sleeplessness they are distinct.

In the chemical, the brain cells are kept awake (stimulated) by fatigue-toxins of an unusual kind or by drugs, for instance caffeine or a *small* quantity of opium.

In the vascular, the excited heart is driving blood too vigorously through the cerebral vessels with the result that the brain-cells cannot rest.

In the sensory type, sensations, it matters not of what kind, cannot be excluded; and in the psychic the presence of thoughts, problems or emotions is keeping the highest portions of the brain in a state of activity.

Now before alluding to the specific remedies for the various forms of insomnia, one ought to say something *on the hygiene of sleep* in its broadest aspects.

And surely this is only a matter of ordinary common-sense. In the first place, no one of whatever age ought to sleep in a room that is not ventilated as well as or better than the so-called "living room" (as though one did not also live in a bedroom!)

It is an axiom in personal hygiene that no one should go to

sleep in an apartment which has not some communication with the outer air.

The number of hours devoted to sleep is a very important point, especially to children and young people.

“The very “*worst*” way

To lengthen the day

Is to steal a few hours from the night.”

with all due apologies to the musical Irishman who said it was the “best.”

Dr. Clement Dukes gives as times to sleep the following: —

Age.	Number of hours to sleep.	Time to be preferred.
Under 6 years.	13	p.m. 6 to 7 a.m. 6
„ 7 „	12.5	6.30 to 7
„ 8 „	12	7 to 7
„ 9 „	11.5	7.30 to 7
„ 10 „	11	8 to 7
„ 13 „	10.5	8.30 to 7
„ 15 „	10	8 to 7
„ 17 „	9.5	9.30 to 7
„ 19 „	9	10 to 7

According to Dr. Clement Dukes the hours of sleep should be in the nursery from 20 to 16 in the 24, in the infant school 15 to 14, in the primary school 13.5 to 10.5, and at a secondary school and at the University 10 to 8. The opinion is rapidly growing that the hours of sleep of young people at school might in many cases be lengthened and that no work, especially mental, should be done before breakfast. The length of time passed in sleep should never be arbitrarily fixed, but made to suit the constitutions of the persons concerned. As regards being awakened, this ought not to be done with undue and especially sudden noise. Particularly for children is a sudden, violent wakening a bad thing, they may start up with a fit of palpitation.

Some over zealous people seem to think that to batter down the door with a shower of resounding blows is the perfect method; “let *all* things be done decently and in order.”

Personally I hold strong views of disapproval about the noise, especially during the night in our great cities, and believe that some of the German methods might profitably be adopted here. In Berlin it was contrary to the law to shout, whistle, or sing in the streets after a certain hour at night. This is called a “free country” in contradistinction to Germany; freedom here very often means freedom to annoy and disturb other people. There are some people so thoughtless, so obtuse in perception and so regardless of the comforts of others that the law must show them how to behave.

I think we might seriously set ourselves to eliminate every source of unnecessary noise.

That some eminent and highly intellectual persons have been

able to go through life with much less than the average or usual amount of eight hours' sleep is indisputable, but what a few men of most robust nervous system have done or can do must not be made a law for weaker brethren.

Napoleon is quoted as one of those who had the "power" of dropping off to sleep at any moment: I am inclined to think that his "snatches of sleep" were pathological and secondary to the grave intestinal disorder from which it was after death ascertained that he had suffered.

Some of his biographers assert that Napoleon could also wake up after any desired interval, the same has been said of certain other well-known people. Some quite ordinary people can also wake when they wish. Physiological psychology has never found a satisfactory explanation of this.

While it is injurious to sleep too little, it is also injurious to sleep too much. It is not good for the brain to be too long in that state of relative anaemia and stagnation of lymph which is characteristic of sleep; but brain-workers at all ages need more sleep than muscle-workers.

As regards insomnia from an over-active heart, the first thing of course to do is to try and find out what is exciting the heart. The thumping, bumping of the heart, whose sounds even may keep a person awake, is very often secondary to mental excitement; it is only common-sense not to engage in exciting occupations as the evening wears on.

But Nature here generally asserts herself, and the presence of fatigue puts an end to the excitement.

A hot bath is an excellent sedative in sleeplessness from excited heart. Although for a short time after the bath the heart *does* beat faster, still the considerable fall of general blood-pressure which is produced by the dilated skin-vessels soon withdraws so much blood from the head that sleep is usually possible.

The soporific and soothing effects of *massage* after a hot bath are well-known to athletes; they ward off the stiffness and pain of muscles and joints which after exercise may cause a troublesome insomnia.

The Turkish bath followed by massage is pleasantly sleep-producing, but it can rarely be had just at the time when and in the place where sleep is convenient.

Sleeplessness from insufficiently powerful fatigue-toxins may often be overcome by gentle exercise taken preferably in the open air about bed-time. A certain distinguished nobleman and politician is said to walk round Berkeley Square in the small hours of the morning when unable to sleep.

The hygienic methods of sleep-induction, as distinguished from the strictly medical, should consist in attempting to bring on sleep through the cardiac factor.

Thus, the effect of a *light* meal late at night is often sufficient to bring on sleep, the slight determination of blood to the stomach and therefore *from* the brain, is apparently all that is

needed. A glass of warm milk at bedtime is, in the experience of many, a good soporific. The tendency to fall asleep after meals, however inconvenient it may be, has thus a physiological explanation. However unwise the "heavy" late supper which has figured so much in cheap comic literature may be, the light refection cannot be regarded as an indiscretion.

The relative position of the head is of some importance in sleep. If a person wakes with a headache and especially also with a flushed face, one should recommend sleeping with the head rather more raised; although the lower the head the less work has the heart to do and therefore the more perfectly is it rested.

Passing to causes of sleeplessness related to *sensory stimulation*, we have oftenest to deal with the simple but none the less tiresome condition of cold feet. One frequently finds that the means taken to draw blood to the stomach—the light meal, the warm drink—are also useful in warming the feet and the body all over. If this or the useful hot bottle is not enough, the feet may be placed in hot water or in hot water and mustard, quickly dried and covered with warm socks. Not a few persons have now discarded cold linen or cotton sheets and have taken to sleeping in blankets. The Jäger Company manufacture a blanket of unsurpassed softness and warmth to the skin.

In a great many cases a hot indiarubber bottle is quite enough; and the prejudices against its use are ridiculous; it is not responsible for chilblains; people who are going to have chilblains will have them do what they will. To be unable to sleep on account of cold feet is often to waste one or two precious hours of the night's rest.

As regards emotional, intellectual and other purely psychic states of sleeplessness, they scarcely come under the cognisance of Hygiene; they are in the domain of psychology which, I need scarcely say, we have no time to look into to-night. What one would have considered intensely distracting in the way of thoughts have not always debarred from sleep; condemned criminals have slept soundly the night before execution, while some people pass sleepless nights if they know that they *must* get up early the next morning. The psychic causes of sleep are precisely those on which to give advice is supreme superogatory.

There is no use telling a man in love that "there are plenty more fish in the sea," or a man wrestling with a mathematical problem that "much study is a weariness of the flesh," or a person who has not got the rent ready that is due to-morrow, that "to-morrow never comes." The mind is obsessed, and so long as it is sleep is impossible or will only come after hours of tossing.

Responsibility, worry and grief must come to all at some time or another during life, else the life they are living is not life at all but a soulless, bloodless simulacrum.

As long as we "walk through the valley of the shadow of

death," times must come of tears and sighs and sleepless eyes—but merciful fatigue is never far distant, and therefore, if it is true (as we have been so often told), that "sleep is the image of death," then there is certainly for each one of us every morning a glorious protoplasmic resurrection.

Amongst all the true things said by our and the world's greatest poet, this was one of the truest—

"We are such stuff as dreams are made on,
And our little life is rounded with a sleep."

Type of Sleep.	Nature of casual factor.	Related pathological variety of sleep.	Related Insomnia.
I. Chemical	Normal fatigue-toxins (+) Sleep after hard muscular, or mental work, men asleep on horseback. Holbein swimming asleep.	Coma from auto-intoxications, and narcosis from drugs.	Of excessive fatigue—"too tired to sleep."
II. Vascular	Diminution of velocity of cerebral blood flow(—)	Fainting from syncope, sleep after meals, baths, before sea-sickness, in balloons, from compression of carotids, trance, narcolepsy.	From over-active heart.
III. Sensory.	Increase of synaptic resistance in sensory cortical centres(+), or diminution of conductivity at synapses. (—)	Coma from concussion, compression, "Strümpell's boy," Hypnotism.	Noise, light, heat, cold, pain or country quiet.
IV. Psychic.	Absence of emotions, ideas, problems, worries, &c.	Sleep of undeveloped nervous systems, of infants, young animals, of persons of low intelligence.	From problems, over-work, worry, grief, joy, of continued mania.



